

The Valley Group

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Increasing Efficiency On The Transmission Grid With Real Time Monitoring

**Joint CEA Transmission Council & Corporate Partners Committee
Strategic Workshop – February 25, 2009**

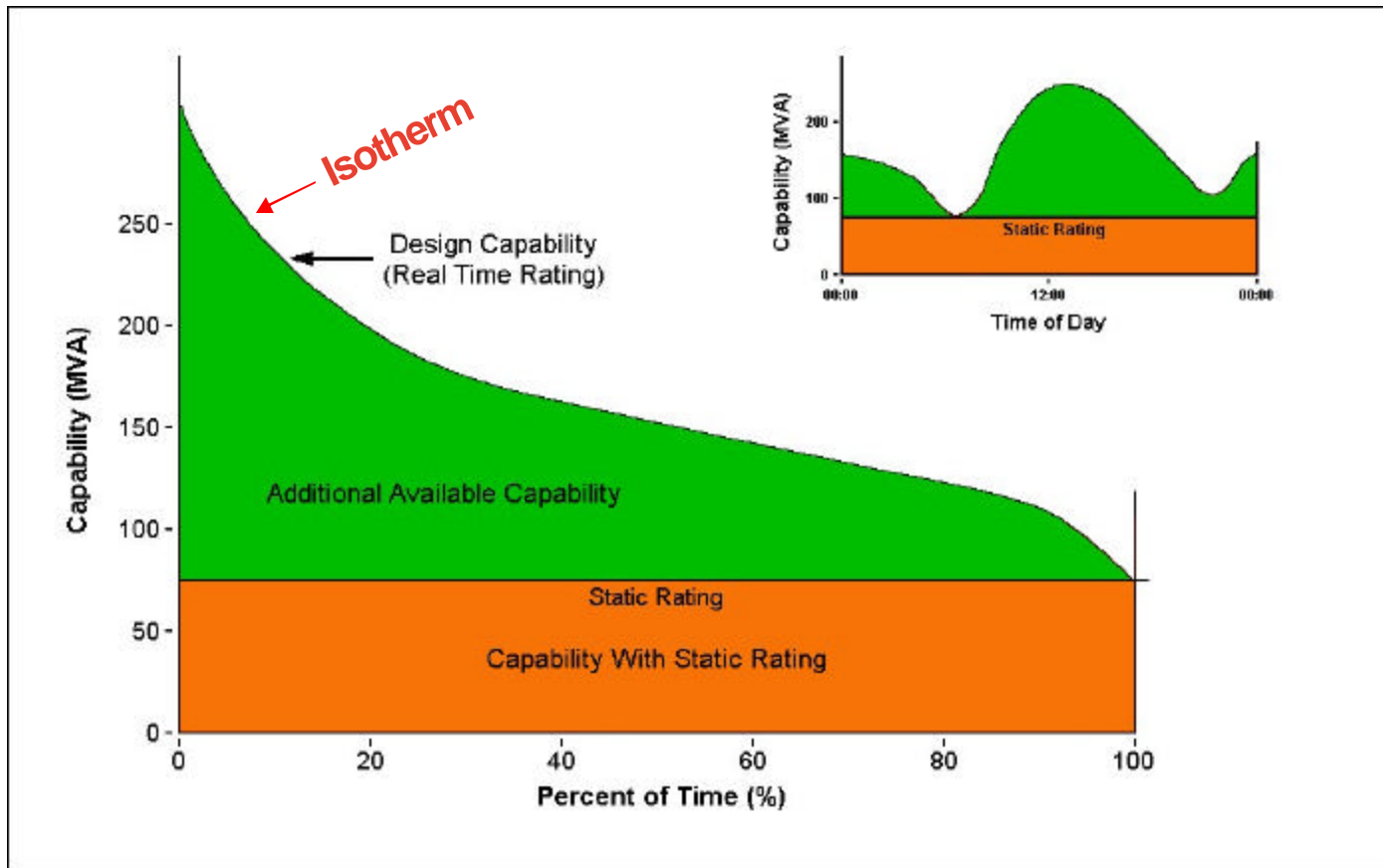
Presented by:
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The Valley Group

**Determine and Harness
Existing, Un-tapped Transmission Capacity
with
Deterministic Safety**

- **Weather conditions affect directly the capacity of an overhead transmission line to transmit power – its rating**
 - Wind speed and direction
 - Solar radiation
 - Ambient temperature
- **Static vs Dynamic Weather Conditions in Determining Line Ratings**
 - Static: Assumes constant weather conditions, over an extended period of time, days, months or years
 - Dynamic: Takes into account changing weather conditions in real time and provides transmission capacity in real time
- **Real Time vs. Static Ratings**
 - Real Time Ratings provide the operator with the overhead transmission line's actual ability to carry power at any moment in time while respecting design limits, such as conductor temperature

Most overhead transmission lines in the nation are operated based on static assumptions

Transmission Line Capabilities Real Time vs. Static Ratings



- **Solar Radiation and Ambient Temperature**
 - Do not vary much spatially and in time
 - Their impact is not as significant as that of wind

- **Wind**
 - Varies **spatially** substantially and randomly
 - Its intensity (speed) can be very different 100 to 200 m away
 - Its direction can vary dramatically in space
 - ...and also
 - Both speed and direction vary **in time** very rapidly and randomly

Typical Example

20 mile transmission line (795 ACSR) with a typical static thermal rating of **787 amps** at 40°C ambient, zero wind, and mid-day in the summer:

➤ **Ambient Temperature:**

- 2°C fluctuation → +/- 2% capacity,
- 10°C drop in ambient → + 11% capacity... 874 amps

➤ **Solar Radiation:**

- Cloud shadowing → +/- a few percent,
- Total eclipse → + 18% capacity... 929 amps

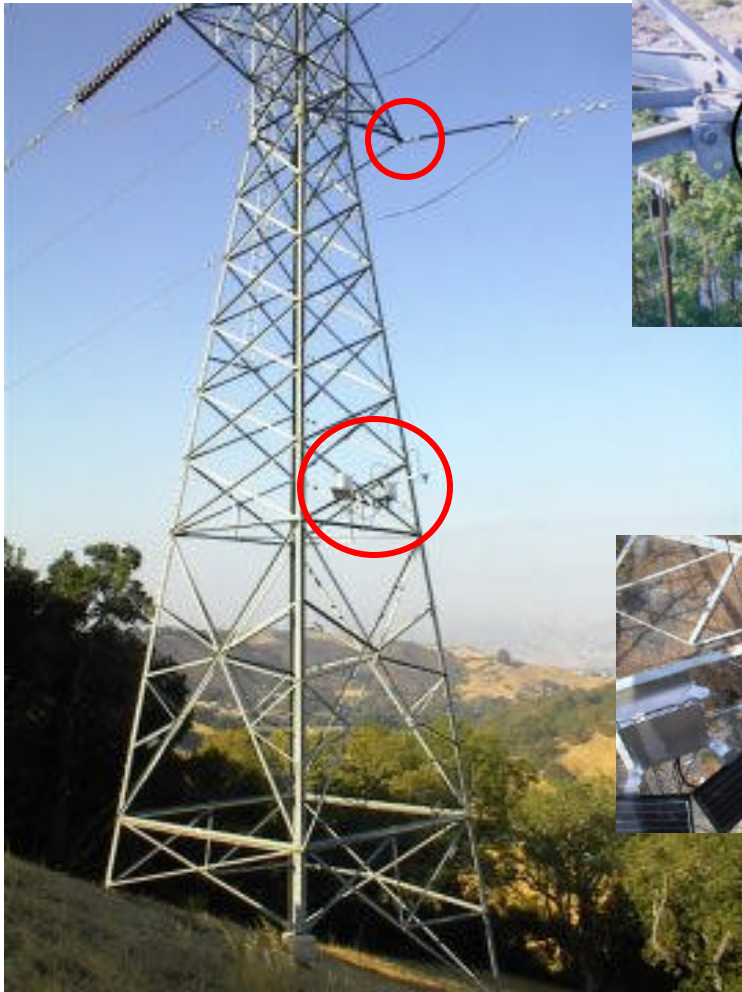
➤ **Wind increase 1 m/sec:**

- 45° angle → + 35% capacity.... 1,060 amps
- 90° angle → + 44% capacity



- Wind patterns on a bay of Great Lake, Tasmania
- Five Minute Intervals
- 8:00 a.m. to 8:15 am
March 1998

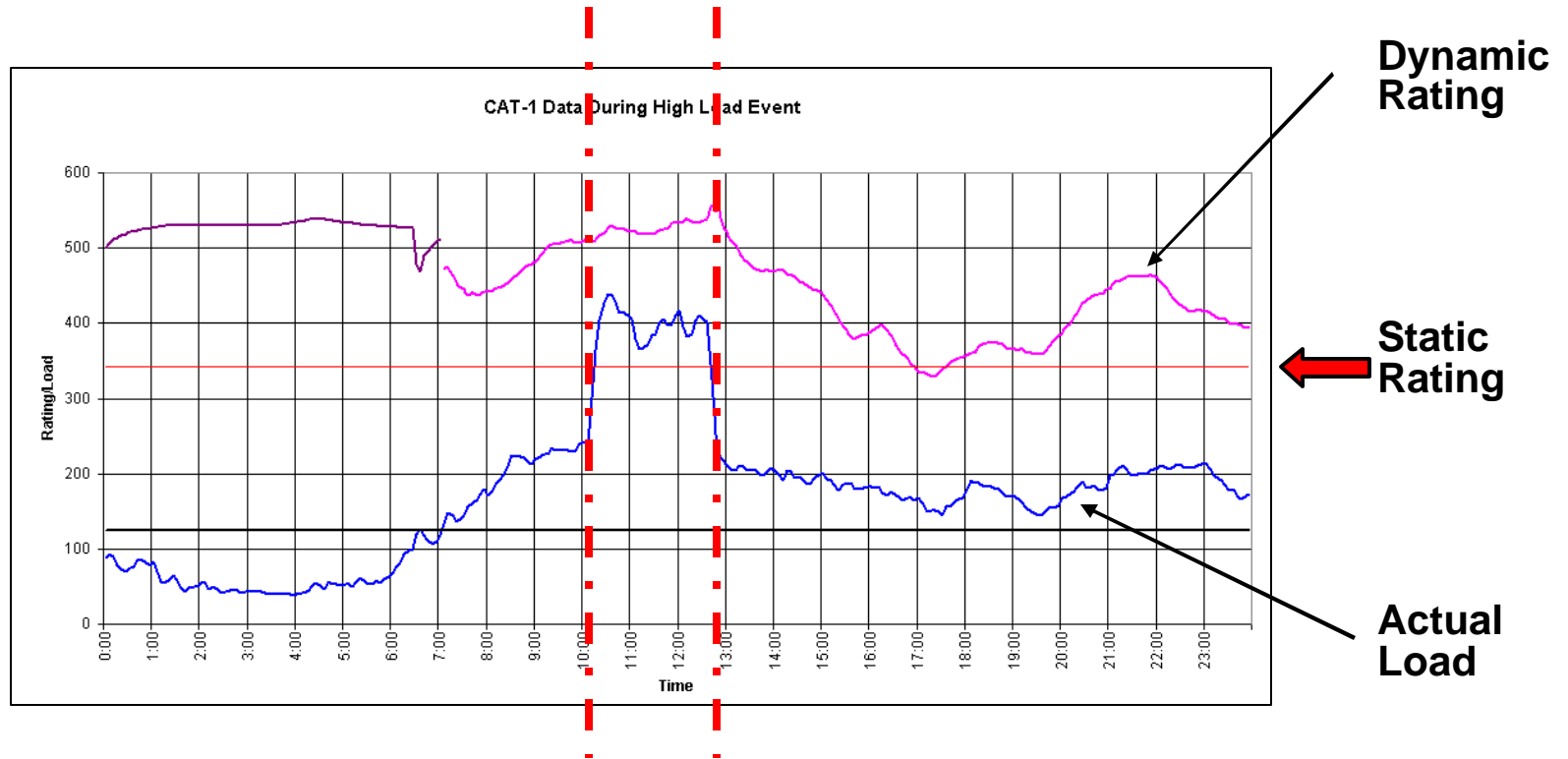
The Product



- Tension-based Real Time Monitoring system for overhead transmission lines
- Tension resolves all environmental factors for accurate results
- Transmission owners can transmit up to **30% more power over 90% of the time**
- Provides **warning for potential overload**
- Communicates with utility's Energy Management System

Real Time Ratings Effective Use

Example of safely managed contingency



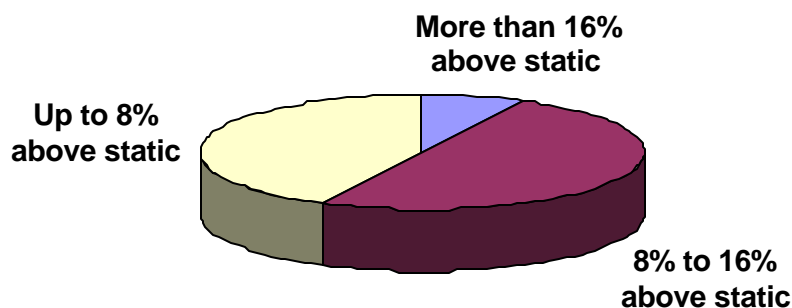
- Line was operating within limits in accordance with NERC standards
- Without RTR, this event must be reported as a violation
- The operator would have been forced to move the grid off its optimum (most secure) dispatch

- Three Major Utilities
- Same Technology
- Different Applications

- LaCygne-Stilwell Flowgate in Southwest Power Pool
- 345KV, 32 miles
- 1251 MVA static rating
- 1 of top 5 bottlenecks on Central U.S. North-South power corridor
- Access to low cost power limited by the LaCygne-Stilwell flowgate
 - Summer – Lower cost power in North flows to South to meet cooling demand
 - Winter – Lower cost power in South flows to North to meet heating demand



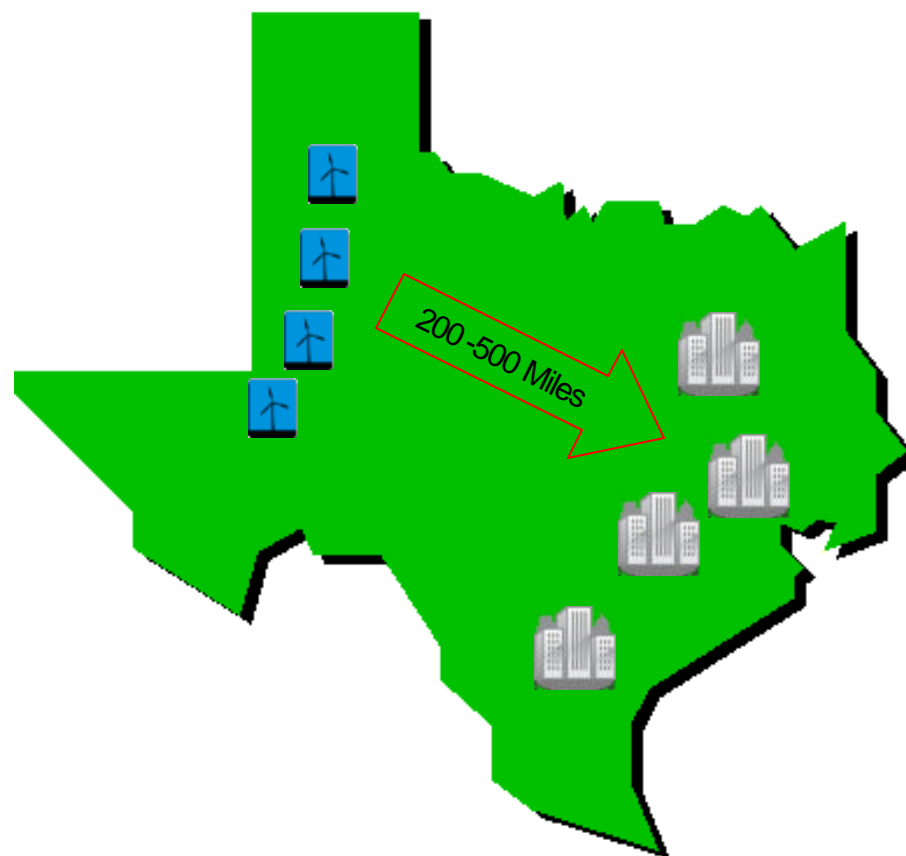
- Line was operated above static limit for **167 hours** late June to early September:



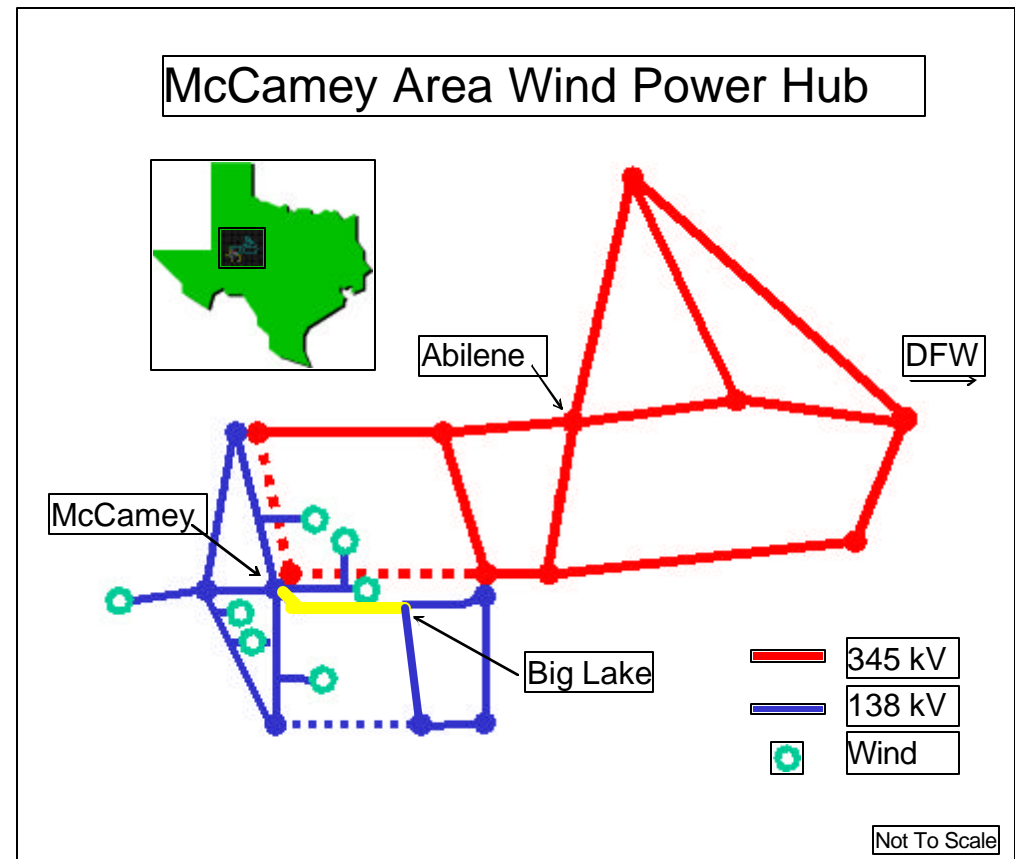
- KCPL avoided “a significant amount” of energy redispatch
- Calculated less than 3-month payback for total installed cost
 - Acquisition, installation and calibration
 - Engineering project management
 - Field verification of readings

- Before installation of real time ratings
 - Firm and Non-firm power contracts were curtailed by the flowgate's constraint
- After installation of real time ratings
 - No curtailment of firm power contracts; increased capacity for non-firm contracts
 - Least cost power delivered to consumers

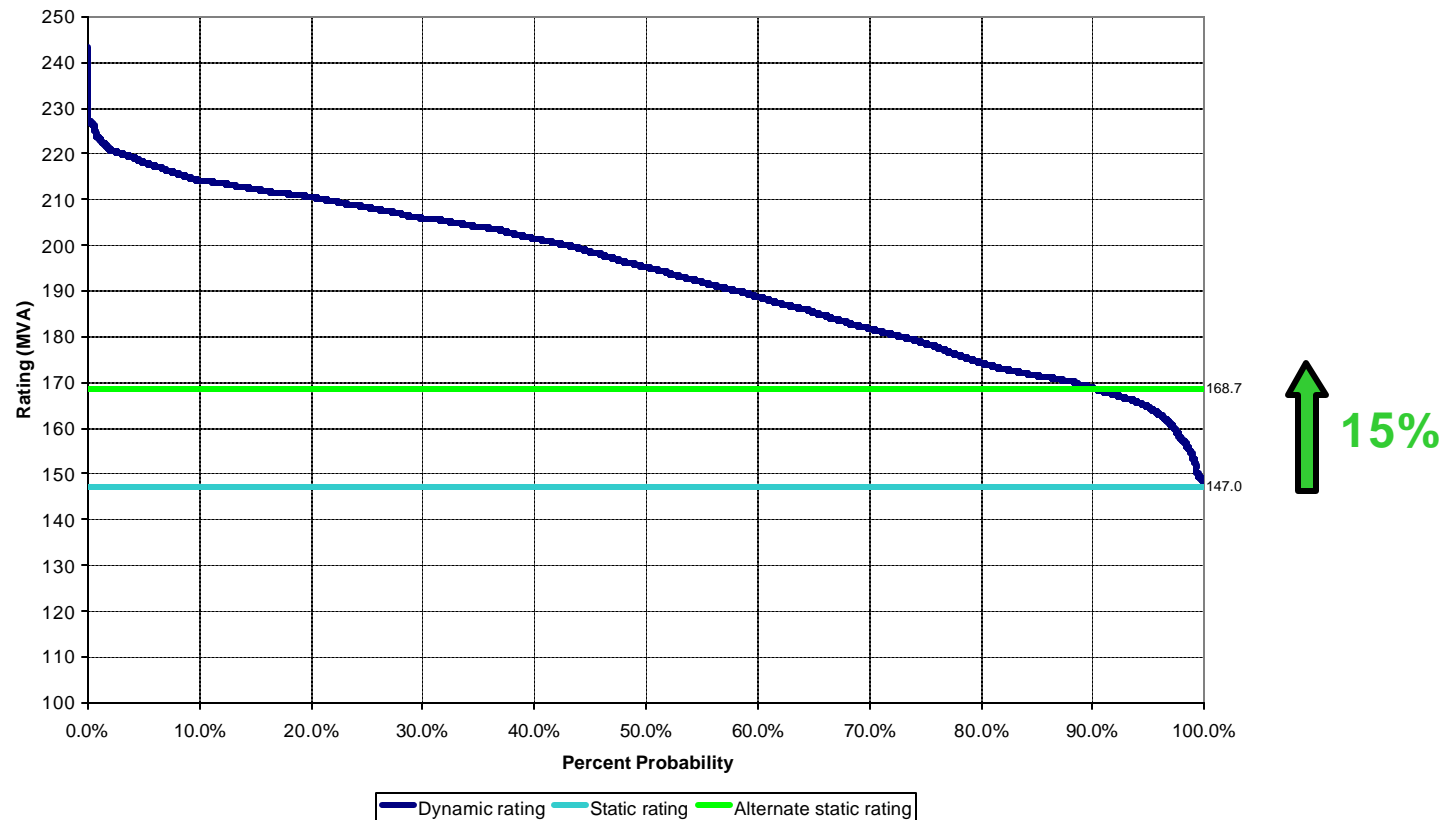
- The best wind is located far from load centers
- Existing transmission capacity is modest in the vicinity of wind farms, and limits the amount of wind power that can be delivered to load centers
- Wind farms are being added faster than transmission lines can be built
- New transmission capacity is planned, but will take years to build



- The power output of several wind farms is concentrated at the McCamey transmission hub
- The amount of wind power that can be delivered to load centers in East Texas is limited by the rating of the 138 kV transmission line from McCamey to Big Lake



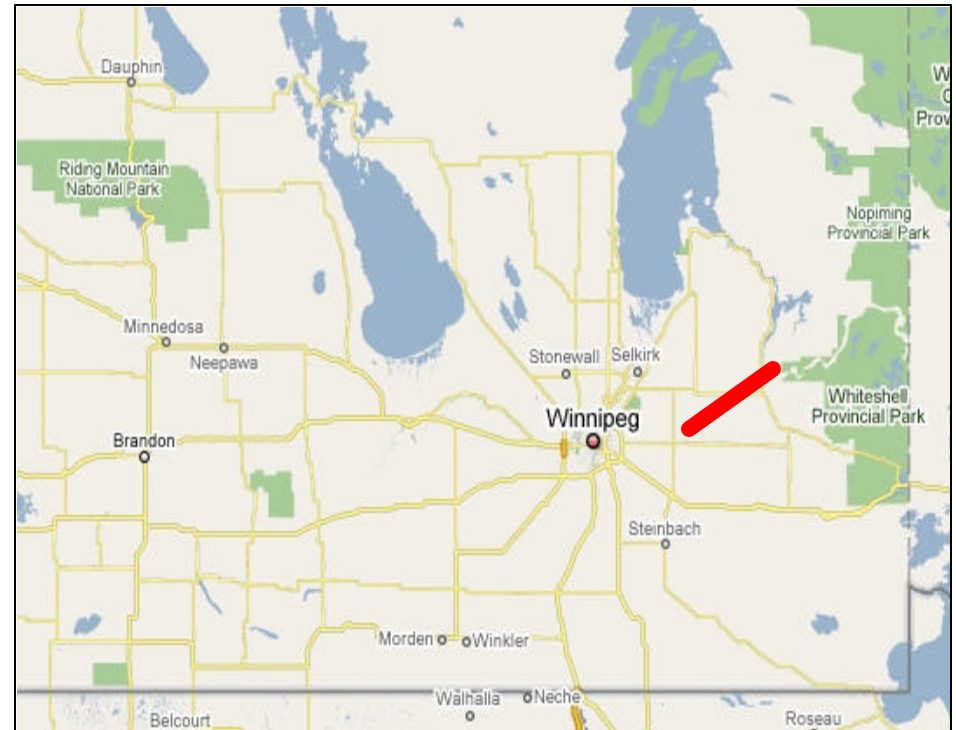
American Electric Power Company, Big Lake - McCamey Line
Dynamic Rating vs. Static Rating, May 2006



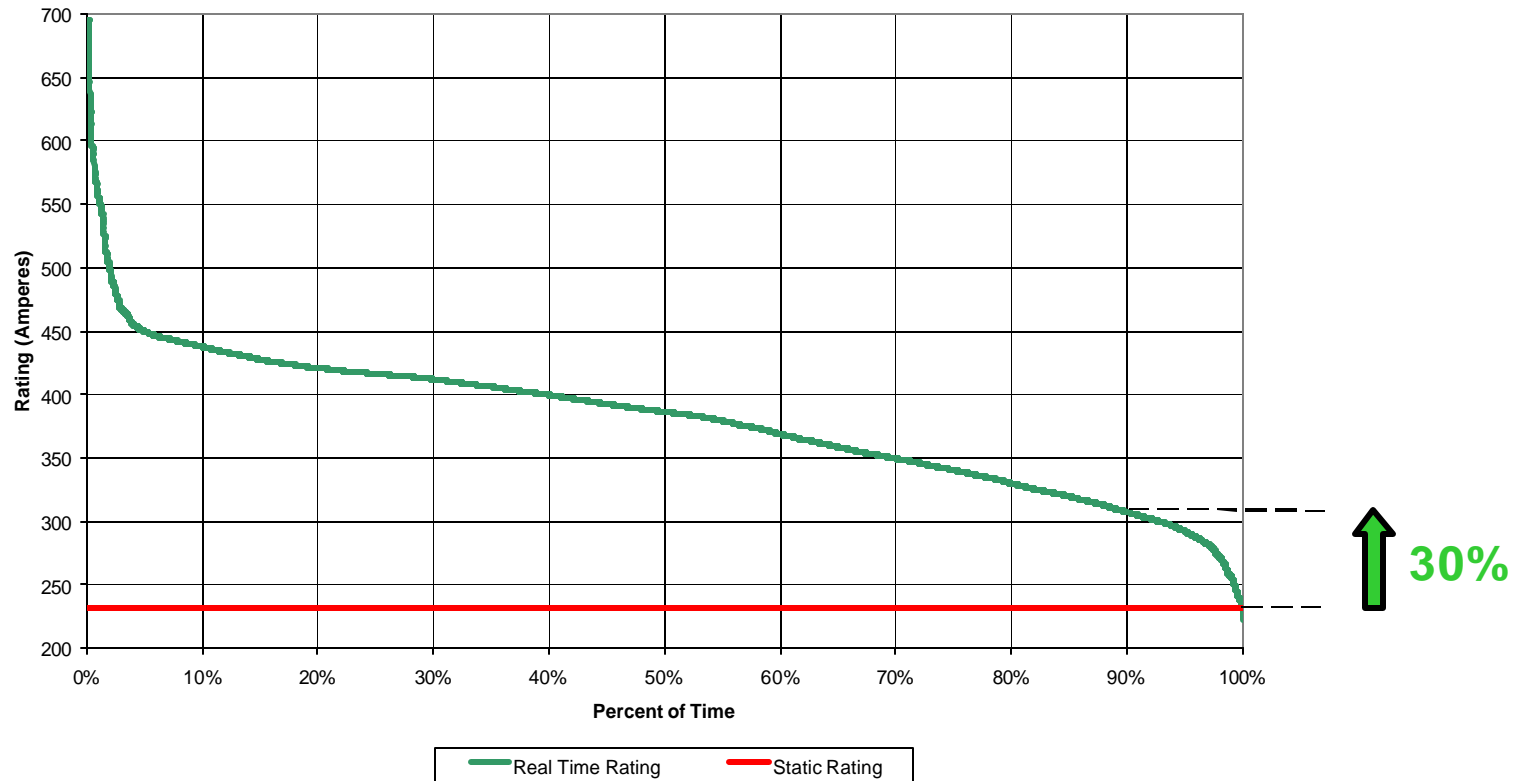
Real time ratings on the McCamey-Big Lake line deliver a minimum of 10-15% above static rating when needed to accommodate wind power

- Real time ratings enabled an immediate 10-15% (minimum) increase in the delivery of wind power over existing transmission assets
 - More renewable energy to market, faster, and at lower cost
 - Maximized use of existing transmission assets
- Real time ratings deferred a physical line upgrade estimated at \$20M
 - The line upgrade would be of no use when planned new transmission lines were completed. A stranded asset was avoided.

- Seven Sisters – Vivian Tap (ST6)
- 115 kV, 45 km
- 232 A static rating
- Intermittent loading constraints result in curtailing low cost hydro generation needed to optimize economic dispatch
- Maintenance and capacity upgrades are planned, but not scheduled for years



Manitoba Hydro - ST6 - July 2002

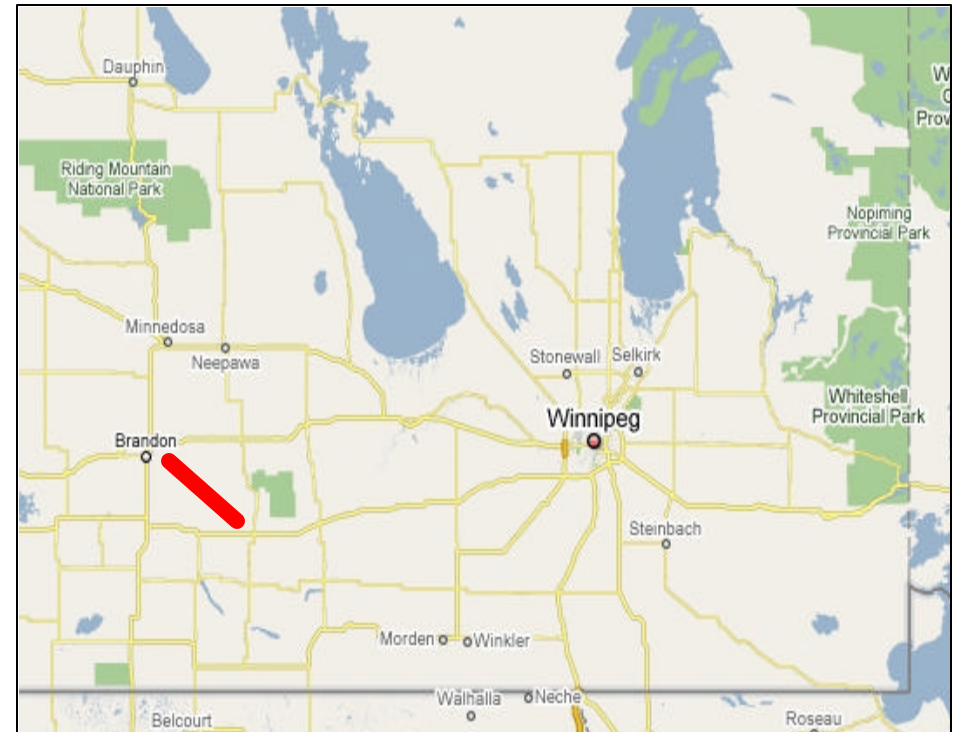


Real time ratings on ST6 are above the static rating 99.9% of the time and 30% above the static rating 90% of the time

- Real time ratings provide access to existing transmission capacity above the static rating
 - Curtailment of hydro generation avoided
 - Lowest cost power delivered to consumers
 - Unnecessary, and potentially reliability threatening, redispatch avoided
- Maximum utilization of the existing transmission asset.
 - Greater ROI
 - Planned upgrades stay on schedule. No artificial and costly acceleration to accommodate unexpected constraints

Manitoba Hydro – Import/Export Case Study (Underway)

- Glenboro - Cornwallis (G37C)
- 230 kV, 51 km
- 702 A static rating
- Power is exported when water levels are adequate, and imported when a water shortage exists
- Wind power is also carried by G37C



- Conditions under which G37C is constrained by its static rating:
 - A prior outage condition exists, or a contingency event has occurred, and
 - Power is being imported because of a water shortage, and
 - Wind power is being generated
- Options that can be exercised under the constrained conditions:
 - Curtail imports and replace them with expensive gas fired generation
 - Curtail wind generation (take or pay contracts)

- Real time ratings have been installed on G37C to handle summer 2009 conditions. Based on prior experience with ST6, it is anticipated that:
 - It will be unnecessary to curtail wind power
 - It will be unnecessary to replace imported power with more expensive gas fired generation
 - Unnecessary, and potentially reliability threatening, redispatch will be avoided

Real Time Ratings enabled all 3 utilities to deliver tangible benefits to electric consumers:

- **Increased access to lower cost/renewable energy**
 - At a fraction of the cost of new line construction
 - In a fraction of the time needed for new line construction
- **Provided a platform to improve grid reliability**
- **Optimized utilization of existing assets**
 - Avoided capital expenditures that would soon become obsolete
 - Extracted full capacity of existing facilities providing a bridge to the construction of new facilities
- **Knowing capacity in real time helps transform overhead transmission from a static asset to a dynamic/smart one, exploring its full design potential**
- **Fast payback**